Revisiting the Issues of Rate Base and Rate of Return in Cable Regulation

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Introduction

This paper discusses the FCC's Report and Order and Further Notice of Proposed Rulemaking, released March 30, 1994, (Report) as it relates to two core aspects of cost of service regulation: the appropriate measure of the rate base and the appropriate rate of return.

Competitive Market Value and the Rate Base

The economically sound value for the rate base is its competitive market value: the market value of the assets that would obtain if the system were facing competition. The Commission has stated, however:

> While it might be possible to develop a different valuation approach, including one of the various approaches suggested by cable operators, we perceive no reason to believe that any one of those methods would better carry out the purposes of the Cable Act. Approaches based on market value at the time of acquisition are likely to include expectations of supra-competitive profits that would be difficult to disentangle from other aspects of market valuation, such as the expectations at the time of the growth and profitability of the unregulated services. We also believe that the commenters favoring market valuation methods understate the practical difficulty of applying sale prices of some systems or trends in stock prices to setting a market price for other systems. Certainly these methods are more complex than use of original cost, even if they could be developed into a reliable valuation method that excludes supra-competitive earnings and non-regulated activities. To the extent that acquisitions occurred at different times in the past, those expectations are also likely to have varied, and use of the full acquisition price is thus likely to produce uneven and unreliable valuations. . . . An attempt to apply a market value test as of the date of the adoption of the Cable Act in 1992 or at some later date presents similar problems of circularity, assessment of

> investor expectations, and allocations to regulated services. (Report, paragraphs 60-61, footnotes deleted.)

The Report does not address in any further detail the competitive-market-value approach.

The Commission acknowledges implicitly the theoretical correctness of the competitive market value approach. Its main stated concern is that the approach is impractical, that there is no operational way to measure a competitive market value. This concern is demonstrably wrong. Devising a competitive market value formula is simple and straightforward. This paper suggests a method for computing competitive market value that is not circular, inconsistent, or difficult to apply to regulated services. This method uses the Commission's own determination of the level of "monopoly mark-up" in the industry; it must therefore be seen by the Commission as completely purging any and all monopoly rents. Furthermore, this method is likely to be far easier to administer than an original cost approach.[1]

Given the Commission's findings so far, determining the competitive market value of a cable system is straightforward. The Commission has found that, due to the market power of "non-competitive" systems, revenue per subscriber in service categories now to be regulated is 17 percent too high. The Commission could easily compute a competitive cash flow based on that 17 percent adjustment. The only other step in arriving at competitive market value is to take that competitive cash flow and apply to it the historical cash-flow-to-market-value multiple in the cable industry.

Specifically, given the Commission's finding, competitive cash flow would be pre-regulation cash flow minus 17 percent of revenue in service categories that are now to be regulated.[2] This value for competitive cash flow assumes that the number of subscribers, other revenue, and costs do not

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1 For a discussion of the administrative difficulty of applying the original cost approach to the cable industry see the Reply Comments of the National Cable Television Association, September 14, 1993. Also, applying the Commission's level of monopoly mark-up in our procedure is not an endorsement of that determination.

2 A formal derivation of the value for competitive cash flow is contained in the Appendix.

change with the decline in prices. To compute the competitive cash flow for any given system, under these assumptions, the Commission would need only that system's pre-regulation values for cash flow and revenue in service categories that are to be regulated. Since all of the information required is historical and based on well-defined accounting concepts, such information would be easy to acquire. The Commission might want to use average figures for, say, the three calendar years prior to the enactment of the 1992 Cable Act.

To determine competitive market value, the Commission would then need to apply an appropriate multiple to the value of competitive cash flow. Table One contains information on cable industry acquisitions in 1989, 1990, and 1991.[3] As that table shows, the average value of a system acquired in that period was 12.4 times the cash flow generated. To compute the competitive market value of a system, the Commission would simply multiply that system's competitive cash flow by 12.4.

For purposes of illustration, industry-wide figures can be used to compute an industry-wide ratio of competitive cash flow to pre-regulation cash flow. During the same three years used to compute the 12.4 multiple, industry-wide cash flow averaged $7,817 million and industry-wide revenue from basic services (including expanded basic and installation revenue) averaged $10,812 million. (The figures on revenue and cash flow are contained in Table Two.) Using these values for cash flow and revenue and applying the procedure described above, it is easy to show that for the entire industry competitive cash flow equals 76.5 percent of pre-regulation cash flow.[4] Using the acquisition multiple of 12.4, competitive market value would equal (12.4 x .765 =) 9.5 times the pre-regulation cash flow. These industry-wide numbers are used only for illustration, and it would be straightforward to apply this approach to any individual cable system. Again, all that is needed are the individual system's 1989-1991 figures for cash flow and for

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3 The data used here are published in "The Cable TV Financial Data Book," Kagan Associates, June 1993. The Commission has the means to review and correct errors, if any, in these data.

4 This result is derived using the formulas in the Appendix and the figures in Table Two. .765 = (7,817-(.17x10,812)) / 7,817.

revenue in categories that are now to be regulated. Only the 12.4 multiple would be applied to all systems.

The Appropriate Rate of Return

On the issue of the appropriate rate of return, the Commission has determined that it will apply an industry-wide cost of capital of 11.25 percent. Much of the Commission's approach, described in paragraphs 147-208 and Attachment D of the Report, is antithetical to an economically sound determination of the cost of capital. The Commission begins by acknowledging that the rate of return should be calculated using a weighted average of the equity and debt costs:

> We conclude that we should use the weighted average cost of capital method, with its cost of equity, cost of debt, and capital structure components. (Report, paragraph 164.)

The Commission summarizes its approach in a table showing equity costs ranging from 12 percent to 15 percent; debt as a fraction of firm value ranging from 40 percent to 70 percent; and a debt cost of 8.5 percent. (See Report, paragraph 205.) The Commission declines to use the standard, economically sound approach for computing the cost of capital. The result is that the Commission systematically understates both the cost of debt and the cost of equity to the cable industry. Using data for seven publicly traded cable companies, we show that the standard approach for computing the cost of capital generates a substantially higher number than that determined by the Commission.

Table Three shows the computation of the cost of capital for seven publicly traded cable companies. The conventional procedure used to compute the cost of capital is based on widely accepted economic principles.[5] The table contains data that would be most relevant for the year 1993, as all figures are end-of-year 1992. The average cost of capital is 13.76 percent.

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5 The procedure is described in virtually every textbook on corporate finance or firm valuation. See, for example, R. Brealy and S. Myers, *Principles of Corporate Finance*, Fourth Edition, 1991.

These data suggest that the Commission's 11.25 percent is more than 250 basis points less than a reasonable figure.

The Commission's approach differs markedly from the approach presented in Table 3. The cost of equity is determined by the historical returns to the overall stock market over and above the returns to a riskless asset (the risk premium) and the historical covariance of the firm's equity returns with those overall market returns (the beta). The Commission accurately describes the standard procedure in Attachment D:

> Risk premium analysis. Risk premium analyses estimate the cost of equity by adding a risk premium to the yield on alternative relatively risk-free investments such as bonds. The risk premium is usually based on a comparison of historic realized returns on stocks and bonds. The current yield on a bond provides an easily determined reference point for current investor expectations on inflation and the general state of the economy.
>
> The parties submitting risk premium analyses relied upon the CAPM variant of this methodology. CAPM uses a general risk premium, based on the differences in return on a risk-free investment and a diversified portfolio of risk-bearing investments, and adjusts it for the target stock's variance in return relative to that of a diversified portfolio. This adjustment is performed through the following formula:
>
> COE = RF + (beta * RP),
>
> where COE is the cost of equity estimate, RF is the current yield on risk-free investment, RP is the risk premium that compensates for the difference in the risk of a diversified, risk-bearing portfolio and a risk-free investment, and beta is a measure of a stock's unavoidable variance in return (i.e., non-diversifiable risk).
>
> The CAPM is based on the widely accepted tenet of finance theory that investors require compensation only for risk (that is, variance in return) that cannot be avoided by holding a diversified investment portfolio. This risk (beta) is often estimated by comparing past variations in the return on the stock and on the stock market overall. . . .
>
> In a previous proceeding we recognized CAPM's potential as a methodology for estimating the cost of capital. However, we found problems in that proceeding -- unrealistic risk premiums and betas -- that precluded our acceptance of CAPM analyses at that time. (Report, Attachment D, Paragraphs 2-5, footnotes deleted.)

The Commission's reasons for dismissing the CAPM approach can be found in paragraph 176 and in Attachment D. The Commission argues that:

> As we note in Attachment D, the high betas of some cable equity issues reflect the closely-held nature of the stock. We believe that the historic pattern of fluctuations in cable stock prices is not purely the outcome of the changing risk-and-return assessments of market investors, but instead reflects in large measure insider decisions regarding cable stocks. Even if cable betas were purely a reflection of the changes in investor evaluations of the risks and return from cable services, we would still have to adjust for the monopoly profit component of investor expectations. We believe that the monopoly profit component was by far the most variable element in investor expectations. We, therefore, given no weight to this source of evidence about the risks of the cable industry. (Report, paragraph 176.)

By ignoring the covariance (the beta) in its approach, the Commission does not account for the relative risk of the cable industry.

The Commission's criticisms of the standard approach are for the most part irrelevant. There is no reason to think that the covariance of cable stocks with the overall market would be related to monopoly profits. Insider holdings is also irrelevant in this context. To the extent that the covariance can be measured, it ought to be taken into account. If the Commission wants to dismiss the ability to measure a true beta, it could take the approach that cable industry cost of equity is the historical return to *small company stocks*. The returns to small company stocks more closely reflect the equity costs of the average cable system than does the return to the S&P 400 relied upon by the Commission. An approach based on small company stocks would generate a cost of equity of 17.6 percent, and a cost of capital of 13.5 percent, both substantially greater than those determined by the Commission.[6]

There is much less equity than debt in the typical cable system, however. For the firms analyzed in Table Three, equity is on average about 35 percent of total value. Most of the actual difference between the Commission's calculation and the one presented here, therefore, comes from the cost of debt side of the equation. The Commission's assumption of debt

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6 The historical return for small company stocks is from SBBI 1994 Yearbook, Ibbotson Associates.

cost of 8.5 percent is simply mistaken. The Commission's discussion, found in paragraphs 184-190 of the Report, displays confusion between short-term working capital costs and long-term debt costs. The Commission's discussion also displays confusion between yield and interest payments. By the Commission's reasoning, if cable firms issued zero-coupon bonds (bonds that have no periodic interest payment), the cost of debt would be zero. Our sample in Table Three uses the actual yield for the end of 1992 on B-rated bonds, the most common rating for these firms. The Commission need not speculate on this point. Information on the yield of various grades of debt is widely available. As it did with the cost of equity, the Commission underestimates the cost of debt to the cable industry.

The approach to measuring the cost of capital presented here is not only economically sound, it is also likely to be conservative given the sample of firms and the nature of the regulations being imposed. The seven firms in the sample are generally larger and, because they are publicly traded, are likely to have easier access to capital markets than the average cable system. For these reasons, they probably have capital costs substantially lower than the average cable system. In addition, the Commission ought to realize that the regulations it is enforcing will increase the cost of capital for all systems. That is, the reductions in cash flow and increases in risk of bankruptcy engendered by the new regulations are likely to increase substantially the cost of capital for cable systems.

Appendix: A Simple Method for Computing Competitive Cash Flow

It is easy to show that only two pieces of system-specific information are needed to calculate competitive market value: pre-regulation cash flow and pre-regulation revenue in service categories that are now to be regulated. As noted, in order to determine competitive market value, competitive cash flow must first be calculated. Cash flow can be disaggregated into its components as follows:

$$1) \quad CF = RR + OR - C,$$

where CF is cash flow, RR is revenue from regulated services, OR is all other or unregulated revenue, and C represents all costs relevant to cash flow. (In the cable industry, the term "cash flow" generally refers to earnings before interest, taxes, depreciation, and amortization.) Next, use the Commission's finding that, due to the market power of "non-competitive" systems, regulated revenue (per subscriber) is 17 percent too high. Hence, according to the Commission, competitive cash flow (CCF) would be:

$$2) \quad CCF = .83\,RR + OR - C.$$

Since OR - C is equal to CF - RR (from the first equation), it is not necessary to determine values for OR or for C. Instead, we can substitute CF - RR for OR - C in equation (2):

$$3) \quad CCF = .83\,RR + CF - RR.$$

Rearranging the terms gives us the simplest form of the value for competitive cash flow:

$$4) \quad CCF = CF - .17\,RR.$$

This derivation assumes that the number of subscribers, other revenue, and costs do not change with the decline in prices. Equation 4 shows that to compute the competitive cash flow for any given system, under these assumptions, the Commission would need only that system's pre-regulation values for cash flow and revenue in service categories that are to be regulated.

Table One
Cable Acquisition Multiples, 1989-1991.

Seller	Buyer	Date Agreed	Subs (000)	Price (mil.)	Multiple of Cash Flow
C.A.T. Partnership	UA Cable/swap	1/89	74	193	12.9
Warner Communications	Time Inc.	3/89	1,583	3,633	12.8
Centel Corp.	Consortium	3/89	588	1,431	13.9
Centel/IL	Jones Intercable	3/89	125	340	14.2
Centel/So. FL	Adelphia Communications	3/89	130	310	13.0
Centel/Central FL	American TV & Communications	3/89	97	251	15.3
Centel/OH	Warner Cable	3/89	74	211	15.9
Centel/MI	C-Tech	3/89	102	210	13.3
Hauser/Minneapolis, MN	King VideoCable	3/89	46	131	13.0
Centel/KY & IN	Simmons Communications	3/89	60	110	12.0
Group W/Chicago, IL	Prime Cable	4/89	115	213	14.5
Times Mirror/MA & NY swap	Cablevision/ AZ	5/89	100	295	14.2
Republic Cable	Cablevision Systems	5/89	47	148	13.9
Valley Cable/CT	Tele-Media	5/89	40	90	11.3
Tele-Media/OH	Warner Cable	5/89	31	70	14.1
American/Pompano Beach, FL	Continental Cable	6/89	115	242	12.6
American/Cambridge, MA	Continental Cable	6/89	55	104	10.9
American/Midwest	Continental Cabel	6/89	44	86	11.0
American/IL	Continental Cable	6/89	41	78	11.8
Better Ent. L.P. I	Adelphia Communications	6/89	30	68	11.7
Cooke Media	Consortium	7/89	674	1,548	12.4
Cooke Cable	Tele-Communications, Inc.	7/89	210	398	12.8
Choice Cable TV	Cencom Cable Associates	7/89	138	377	13.1
Cooke Cable	Rigas Family	7/89	80	193	12.5
Cooke Cable	TCA Cable	7/89	90	183	11.6
Cooke Cable	Falcon Commuunications	7/89	47	96	10.8
Cooke/Chico, CA	Chambers Communications	7/89	29	63	11.3
Jones 11-B	Adelphia Communications	8/89	33	81	14.0
Joseph Gans	Adelphia Communications	8/89	31	69	14.4
Jones 10-C	Cablevision Industries	8/89	22	53	12.8
Heritage/Dallas, TX	Tele-Communications, Inc.	9/89	105	304	13.9
Comcast Investors	Comcast Corp.	9/89	53	113	15.0
Jones 11/A-F	Crown Cable	10/89	136	265	13.2
First Carolina	Falcon Communications	10/89	92	185	11.2
Tele-Media/OH, KY	Vista Communications	10/89	28	56	14.9
Adelphia Communications	Olympus L.P.	12/89	54	181	14.8
Star Cable	Marcus	1/90	61	118	10.4
Colonial Cable	Continental Cable	1/90	20	61	12.9
Ingersoll Industries	Warner Communications	1/90	22	52	13.9
Insight Communications	Cencom Cable Associates	3/90	72	165	11.6
ML Media	InterMedia	6/90	42	85	12.0
Jones/Flossmore, IL	Jones Fund I5-A	6/90	23	71	13.4
Daniels/CA & LA	United Cable	2/91	39	76	10.5
Karnack Corp.	Tele-Communications, Inc.	2/91	45	53	8.7
King VideoCable	Colony/ Keslo	3/91	210	340	10.0
Star Cable Group	InterMedia	7/91	110	165	8.2
Gilbert/Newark, NJ	Cablevision Systems	10/91	42	78	8.9
MN & ND	New Heritage	11/91	78	182	11.0
Simmons/Long Beach, CA	Cablevision Industries/KKR	12/91	66	133	9.3
Cox/NY swap	Time Warner/ FL Swap	12/91	60	125	8.2
				Average:	**12.4**

Note: List of 100% acquisitions with no debt assumption.

Source: The Cable TV Financial Databook, Kagan Associates, June 1993, pages 131-135.

Table Two
Cable Revenue, 1989-1991

Year	Basic Revenue	Install Revenue	Expanded Basic	Total Basic Revenue	Total Revenue	Cash Flow
1989	8,670	213	267	9,150	15,678	6,900
1990	10,169	239	495	10,903	17,855	7,800
1991	11,414	262	706	12,382	19,743	8,750
			Average	10,812	17,759	7,817

Note: Figures are in millions.
Source: The Cable TV Financial Databook, Kagan Associates, June 1993, pages 8, 86.

Table Three

Cost of Capital: Representative Publicly Traded Cable Companies, 1993

Cable Companies	1 Debt d	2 Equity e	3 Cost of Debt Rd	4 Beta B	5 Risk Free Rate Rf	6 Equity Risk Premium Rp	7 Cost of Equity Re	8 Cost of Capital Rc
Adelphia	1,554	218	11.24	1.76	5.27	8.60	20.41	12.37
Cablevision Systems	1,914	796	11.24	1.70	5.27	8.60	19.89	13.78
Century Communications	1,175	697	11.24	2.05	5.27	8.60	22.90	15.58
Comcast	3,974	2,632	11.24	1.57	5.27	8.60	18.77	14.24
Jones Intercable	299	177	11.24	1.80	5.27	8.60	20.75	14.78
Jones Spacelink	364	70	11.24	2.17	5.27	8.60	23.93	13.29
TCA Cable	130	528	11.24	0.85	5.27	8.60	12.58	12.32
Cable Company Average	1,344	731	11.24	1.70	5.27	8.60	19.89	13.76

Sources:

1) Long term debt from Kagan, end of year 1992, millions.
2) Equity from Kagan, end of year 1992, market value, millions.
3) Cost of debt from S&P Bond Guide, B Rated Industrial Bond Yields, December 1992.
4) Beta from S&P Compustat, end of year 1992.
5) Risk free rate from S&P Bond Guide, short term government bond yields, December 1992.
6) Risk Premium = Difference between returns, stocks v. short term government bonds, arithmetic means, from SBBI 1994 Yearbook, Ibbotson Associates.
7) Cost of Equity, $Re = Rf + B(Rp)$
8) Cost of Capital, $Rc = Re(e/(d+e)) + Rd(d/(d+e))$.

ATTACHMENT F

"Prices Above Book Values Do Not Imply Market Power"

Economists Incorporated
August, 1993

(originally submitted as Appendix A to
NCTA Comments in MM Docket No. 93-215)

APPENDIX A

Prices Above Book Values Do Not Imply Market Power

I. Introduction

The Commission has tentatively decided to "adopt an original cost methodology to determine the value of a cable operator's plant in service for rate base purposes," and to exclude "excess acquisition costs from rate base, including portions assigned to goodwill, customer lists, franchise rights, and other intangible assets."[1] This decision seems to be based on the view that any acquisition value above original cost is an indication of monopoly rents and, therefore, should not be included in the rate base.

This paper presents evidence to the contrary. We analyze the reasons why the market value of assets would be expected to exceed book value whether an industry is competitive or not. We examine the average annual market-to-book equity ratios for S&P 500 firms from 1977 to 1992, showing that the average ratio always exceeds one.

Finally, we examine the harm that will be caused if the Commission adopts an original cost rate base, or any other rate base that does not reflect the value of intangible assets. An insufficient rate base will cause under-investment in the future and will encourage degradation of existing assets, to the detriment of consumers.

II. Market prices differ from book values for a variety of reasons

A firm's assets are commonly categorized as tangible or intangible. Physical capital is a tangible asset; the remaining value of the firm constitutes intangible assets. Intangible assets can comprise a large and vital part of a firm's investment. Intangible assets have been defined as the

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1 FCC, "Notice of Proposed Rulemaking," MM Docket No. 93-215, July 15, 1993, paragraph 35.

long-lived legal rights and competitive advantages that are developed or acquired by a business.[2] In this paper, we decompose intangible assets into those two components; referring to long-lived legal rights as organizational capital and competitive advantages as economic rents.

A firm's market value is the present discounted value of the income expected to be generated by the assets of the firm in the future. A firm's book value is the depreciated value of what past and present investors have put into the firm, as measured by accounting standards. A firm's market value will diverge from its book value for several reasons, including:

(1) inflation,

(2) divergence between real and accounting rates of depreciation,

(3) organizational capital,[3]

(4) quasi-rents,

(5) monopoly rents.

Most of these factors cause the market value of any viable firm to exceed its book value. The first two factors are reasons why market value may differ from book value even in the absence of intangible assets. The next three factors represent intangible assets. These intangible assets, and other factors, can affect the market value of a firm while leaving its book value unaffected. For example, the rate at which expected income is discounted could change for reasons of time preference or risk. Expected income before discounting can also change due to changes in any of the above listed factors. We discuss each of these factors in turn.

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2 This definition is from Williams, Jan R. and Martin A. Miller, *GAAP Guide 1993,* Harcourt, Brace, Jovanovich, New York, 1993, p. 21.01.

3 The term "organizational capital" comes from Cornell, B. and A. Shapiro, "Corporate Stakeholders and Corporate Finance," *Financial Management,* Spring 1987, pp. 5-14. The bulk of a firm's intangible assets will take the form of organizational capital.

Appendices

Appendix 1
Statistical Analysis of FCC Database

Appendix 1: Statistical Analysis of FCC Database

Our analytical effort focused on identifying rate-related attributes that differentiate large and small cable TV systems. In this appendix we describe the statistical methods that were used to ascertain key differences between large and small systems. Unless otherwise noted, size is based on the number of subscribers served by the system; the franchise is defined as *small* if the system in which it operates serves less than 5,000 subscribers, while it is considered *large* if the system serves more than 5,000 subscribers.

In the discussion that follows, the results, conclusions, and inferences are limited to the 420 franchises considered by the FCC in establishing their competitive benchmarks. There are severe shortcomings in the database itself, which we have purposefully ignored in carrying out our assignment. These shortcomings include the following:

- *Inherent bias* in the sample; bias can be introduced at each step in which the sample is modified, filtered, or deviates in any way from the original design or intended purpose. In Appendix C - Technical Appendix, the FCC depicts extraordinary departures from the original sample design which includes a 1% random sample augmented by three additional targeted strata. The complex manipulation of sample respondents prohibits the estimation of sampling error (that is, precision), and it is unclear how the sample data could be weighted (if at all) to calculate any estimate whatsoever (e.g., total cable subscribers) that can be reliably projected to the population of all franchises and/or cable systems.

- In evaluating the accuracy of a survey, two sources of error occur; namely,

  (i) *sampling error*, which accounts for the variation inherent in selecting a valid probability sample; and

  (ii) *Non-sampling error*, which includes the effect of (among other things) non-respondents, incomplete and inadmissible responses, and data errors and omissions of all kind.

The latter is not only difficult to quantify, it is also generally more serious. In the highly acclaimed brochure "What Is a Survey?" published by the American Statistical Association (1980), the authors elicit practical guidelines for conducting a survey. In the discussion on non-sampling errors, they state the following:

> "By examining the procedures and operations of a specific survey, experienced survey statisticians will frequently be able to assess its quality. . . . In most cases, the analyst can only state that, for example, the errors are probably relatively small and will not affect most conclusions drawn from the survey, or that the errors may be fairly large and inferences are to be made with caution."

In light of the procedures used by the FCC in creating the analytical data base, it is highly unlikely that an experienced survey statistician would be willing to estimate rate structures based on this sample of 420 franchises.

Although these concerns are critical in the sense that biased samples tend to yield biased results, we have restricted our analysis to the same database used by the FCC in order to illustrate fundamental concepts in statistical analysis and data interpretation that are vital to the rate-setting process.

This appendix is structured according to the following topics:

1. Analytical objectives of our assignment;

2. Identification of relevant rate-related factors, including summary tabulations and descriptive statistics;

3. Analytical methods; namely

   - Logistic regression (discriminant analysis)
   - Cluster analysis
   - Analysis of variance (ANOVA)

4. Regression diagnostics and robustness issues encountered in the FCC analysis.

Each of these topics is discussed in detail in the remainder of this appendix.

1. Analytical Objectives

The primary objective was to identify key technology and/or economic factors that were substantially different between large and small systems. As indicated in Table 1, the FCC database clearly revealed a significant competitive price differential for small cable systems, but the difference was negligible for franchises operated by larger systems.

Table 1. Average Revenue (ARIEPS) for 420 Sample Franchises

	Small		Large	
Environment	**No. of Franchises**	**Average Revenue**	**No. of Franchises**	**Average Revenue**
Non-competitive	207	$21.09	163	$22.58
Competitive	29	$15.39	21	$22.12

Although the FCC regression model purports to relate the variability in ARIEPS to several explanatory characteristics, one of which (OVL) is a surrogate for a competitive environment, the model does not explicitly account for the interactive effect suggested in Table 1. Furthermore, the lower average revenue corresponding to the 29 small competitive franchises could possibly be attributed to several other factors associated with operating a cable TV system. In particular, we hypothesized that differences in revenue were likely to be explained by various cost and investment factors, both individually and in combination, that were neither included, nor considered as candidates, in the FCC regression model.

If we could objectively establish significant differences in economic factors associated with operating large and small systems, then the difference observed in the ARIEPS term given in Table 1 could have a more plausible explanation. Consequently, the primary objective was to identify economic-related characteristics that were effective discriminators in operating large and small cable systems.

As a secondary objective, we examined the sensitivity or "robustness" of the FCC regression analysis. Since the FCC model is intended for use as a benchmark, it is critical that predicted revenues are not unduly influenced by a small number of statistical outliers present in the database. It is well-known that estimated coefficients and predicted values (e.g., average revenue) based on regression analysis can be very misleading and unreliable in the presence of outliers. Consequently, we have also investigated the relative effects of influential observations in the FCC database.

2. Identification of Relevant Factors

We focused on characteristics measured in the FCC survey that captured elements of the investment and cost structure associated with operating a cable TV business entity. As a result, the factors listed in Section 3.1 of the report were selected as candidates for our analysis.

We then generated summary tables and various descriptive statistics for each factor in the list. An illustrative example is given in Table 2 for the factor S7_TSAT, which measures the total number of satellite-delivered cable channels at the franchise level. Since we are primarily interested in differences associated with franchise size and competitive environments, the tables were structured accordingly. A complete list of similar output for all factors is given in Volume 2, Output of Statistical Analyses. These tables were useful in displaying the underlying structure of the data, such as frequency distributions, extreme values, and other statistical properties of interest when performing exploratory data analysis. This step, for example, aids in the detection of statistical outliers and data errors, if present.

Table 2. Summary Statistics (Illustrative Example)

NCTA - Analysis of Survey Results
Tabulation of s7_tsat by size and compet. type

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S7_TSAT	System Size								Total			
	Small				Large							
	N	Average	Std. Dev	Sum	N	Average	Std. Dev	Sum	N	Average	Std. Dev	Sum
Competition Type												
Non-Competitive	207	13.51	6.92	2797.00	163	22.99	5.74	3747.00	370	17.69	7.96	6544.00
Competitive	29	22.76	6.75	660.00	21	25.86	5.96	543.00	50	24.06	6.55	1203.00
Total	236	14.65	7.52	3457.00	184	23.32	5.82	4290.00	420	18.45	8.07	7747.00

NCTA - Analysis of Survey Results
Univariates for s7_tsat - Overall

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Univariate Procedure

Variable=S7_TSAT

Moments

N	420	Sum Wgts	420
Mean	18.44524	Sum	7747
Std Dev	8.068581	Variance	65.10201
Skewness	0.246784	Kurtosis	0.238888
USS	170173	CSS	27277.74
CV	43.74344	Std Mean	0.393706
T:Mean=0	46.85023	Prob>|T|	0.0001
Num ^= 0	416	Num > 0	416
M(Sign)	208	Prob>|M|	0.0001
Sgn Rank	43368	Prob>|S|	0.0001
W:Normal	0.98101	Prob<W	0.1658

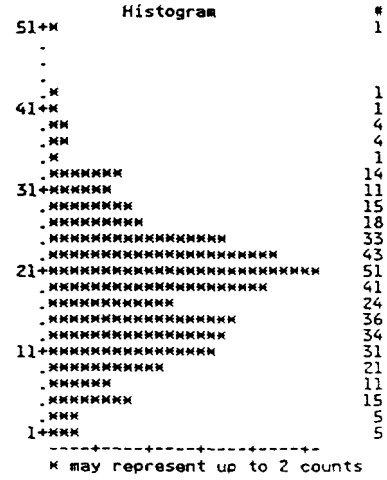
Quantiles(Def=5)

100% Max	50	99%	39
75% Q3	23	95%	32
50% Med	19	90%	28
25% Q1	13	10%	8
0% Min	0	5%	5
		1%	1
Range	50		
Q3-Q1	10		
Mode	20		

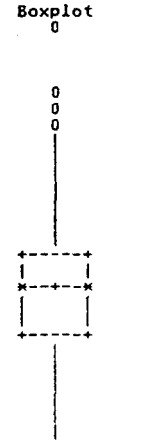
Extremes

Lowest	Obs	Highest	Obs
0(	398)	39(	51)
0(	334)	39(	214)
0(	134)	40(	75)
0(	131)	42(	11)
1(	382)	50(	86)

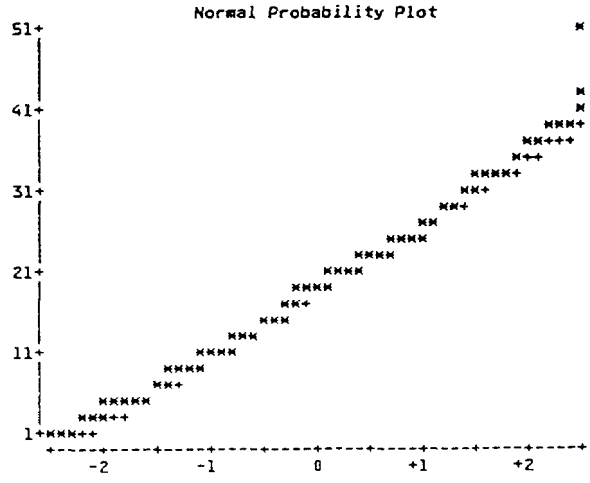
Histogram



Boxplot



Normal Probability Plot



3. Analytical Methods

3.1 Logistic Regression

Each franchise is characterized by a vector of numerous cost- and investment-related variables. We then identified variables that differ dramatically between large and small systems. Due to the dichotomous nature of the outcome variable (i.e., small or large), we used a technique known as logistic regression to examine relationships between system size and the candidate variables.

In particular, we used a step-wise technique described in an article by Efron and Gong appearing in *The American Statistician*, Feb. 1983. With this procedure, each variable is considered independently, and is tested to see if it differs (on average) between the two groups. If not, it is ignored in subsequent steps since it has no real discriminatory capability. Separate analyses were conducted within the subset of 370 noncompetitive franchises and the complementary subset of 50 competitive franchises.

Again, using total satellite channels to illustrate the concept, key results are displayed in Table 3 and are interpreted as follows.

Table 3. Logistic Regression Output

	Estimate	Standard Error (S.E.)	Weight of Evidence
Non-Competitive Sample	0.248	0.027	<0.001
Competitive Sample	0.078	0.048	0.104

If the estimate is not significantly different from zero, the characteristic has no real discriminatory capability. Significance, or weight-of-evidence as given in the table, is usually established with a level less than 0.05, or sometimes 0.10. In any event, it is evident that the number of satellite channels differs between large and small systems to a greater extent for franchises in the non-competitive subset than their counterparts in the competitive subset. This finding is consistent with the data given previously in Table 2, and supports the contention (not surprisingly in this example) that franchises in large systems have more satellite channels than those in small systems.

Interpretations similar to the foregoing were formulated for each factor.

The first step served as a screening mechanism to eliminate factors from further consideration. The next step involved the combination of factors, known to be good discriminators, into a model that would improve discriminatory capability of the cost and investment characteristics overall.

The preferred technique is sequential in the sense that variables are entered one at a time as long as the model is substantially improved. Only the final model will be presented here; its application is illustrated in Table 4 using data for two franchises in the competitive sample, both located in Alabama.

Table 4. Logistic Regression

(Illustrative Example)

Attribute	Estimated Coefficient	Huntsville (AL0012)	Troy (AL0127)
Subscribers		36,948	3,094
Model Variables			
• Income	0.00031	$31,900	$17,365
• Total Channels	0.222	40	44
• MSO Owner	3.679	1 (Yes)	1 (Yes)
• Density(HP/Mi)	0.110	87.7	44.8
• Intercept Term	-26.69		
Size Index[a]		+5.45	-2.90
Likelihood franchise is large[b]		0.996	0.05

[a]Index = -26.69 + 0.00031 (Income) + --- + 0.110 (Density)
[b]Likelihood = $e^{Index}/(1 + e^{Index})$

Based on the four economic attributes listed in Table 4, a "Size Index" is calculated, and then converted to a probability (or likelihood) that the franchise actually belongs to a large cable system. In the illustrative example, both franchises are correctly classified; however, this is not always the case. In fact, the model (in Table 4) resulted in the following classification table for all 50 competitive franchises:

	Competitive Subset Classified by Model as:		
Actual Size	**Large**	**Small**	**Total**
Large	*17*	4	21
Small	5	*24*	29

It is often informative to examine the misclassified observations in greater detail to understand the underlying "cause." For example, the 4 misclassified large franchises that have economic attributes more closely associated with small counterparts were the following:

Franchise	Income	Total Channels	MSO Owned	Density
FL 0679	$19,415	41	Yes	61.4
MD 0009	$26,084	45	Yes	46.1
MI 0011	$25,646	36	Yes	63.2
PA 0552	$21,424	56	No	49.0

Generally, these franchises are located in relatively low median income areas, offer fewer channels, and exhibit lower density (homes passed per mile) than most large systems, as illustrated by the following averages for the two size categories:

Size	Income	Total Channels	MSO Owned	Density
Large	$32,200	47	90% Yes	90.8
Small	$21,300	39	48% Yes	52.1

The five small franchises that were misclassified have the following attributes which in aggregate are more commonly associated with larger systems:

Franchise	Income	Total Channels	MSO Owned	Density
AL 0380	$17,365	66	No	57.5
AR 0026	$20,249	52	Yes	55.7
IL 0883	$31,007	36	Yes	50.9
IN 0531	$28,460	40	Yes	50.7
KY 0867	$34,125	42	Yes	26.1

It should be noted that the telephone survey conducted as part of this study subsequently revealed that KY 0867 is actually a large system. Nevertheless, the model is seen to classify 41 of the competitive 50 franchises in the "correct" size category.

A similar analysis was conducted separately for the 370 non-competitive franchises. Once again, the model was very effective in identifying factors (both individually and jointly) that were significantly different between large and small systems. The classification table given below shows that nearly 85% of the franchises are correctly classified; four observations were deleted due to missing values.

Non-Competitive Subset
Classified by Model as:

Actual Size	Large	Small	Total
Large	136	27	163
Small	29	174	203

The economic-related factors that collectively provided the best discrimination for the non-competitive franchises included all four attributes appearing in the competitive model, plus an additional term measuring penetration (subscribers/homes passed) in the system.

The key analytical finding here is twofold, namely:

- franchises in small systems are demonstrably different from those in large systems; and
- the difference can be expressed in economic and technology terms.

All of the results supporting the discussion above are available as computer output given in Volume 2.

3.2 Cluster Analysis

Another analytical technique that is useful in searching for commonalities among a large number of observational units is Cluster Analysis. The objective in the context of this assignment was to create subgroups of sampled franchises whereby franchises within a subgroup possessed similar financial and economic characteristics, but the subgroups themselves would be substantively different. If the technique is reasonably successful, franchises within each subgroup would provide a sound basis for comparison, particularly with respect to average revenues derived from the survey.

In this analysis all 420 franchises were considered. As before, we focused on the set of cost/investment factors (23 variables in all) to form the clusters. Each variable is initially standardized by subtracting the mean of all 420 observations and dividing by the standard deviation. This step tends to convert all variables to comparable units prior to forming clusters, since variables with numerically large variances tend to have greater influence on cluster formation.

Results are summarized in Table 5. Five clusters included most of the franchises; fifteen franchises were distributed among five other clusters implying that their characteristics were somehow unique and dramatically different from the majority of sampled franchises.

Table 5. Summary of Rate Differences Within Franchise Clusters

Cluster ID[a]	Sample Subgroup	No. of Small Franchises	Average Revenue	No. of Large Franchises	Average Revenues
A (2)	Non-comp. Competitive	0 0	NA NA	15 1	$22.75 24.74
B (3)	Non-comp. Competitive	35 7	$20.11 13.28	47 5	22.44 22.86
C (4)	Non-comp. Competitive	26 5	21.11 17.70	15 2	23.77 22.00
D (7)	Non-comp. Competitive	132 11	21.27 15.80	20 2	21.02 17.62
E (9)	Non-comp. Competitive	14 6	21.85 15.15	53 9	22.62 23.28
All Others	Non-comp. Competitive	0 0	NA NA	12 0	23.53 NA

[a]Number in ( ) refers to Cluster ID number in computer output given in Volume 2.

Comparisons of average revenue (ARIEPS) within each of the four main clusters simply confirmed the contention that a competitive price differential exists only among franchises operated by small systems.

For the sake of completeness, we also determined the basic features of franchises clustered together. To do this, we performed a Principal Component Analysis (PCA) within each cluster to identify those attributes that were dominant in forming each cluster. Results are given in Volume 2 and discussed in Section 3.2 of the report.